JAN McLIN CLAYBERG
PATENT AND TECHNICAL TRANSLATION

JAN McLIN CLAYBERG*
OLAF BEXHOEFT**

CERTIFIED BY AMERICAN TRANSLATORS ASSOCIATION
* GERMAN AND FRENCH TO ENGLISH
** ENGLISH TO GERMAN

5316 LITTLE FALLS ROAD
ARLINGTON, VIRGINIA 22207

TELEPHONE (703) 533-0333
FACSIMILE (703) 533-0334
JANCLAYBERG@YAHOO.COM

March 21, 2005

DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the German text of PCT/DE2003/002998, filed on 09/10/2003, and published on 04/15/2004 under No. WO 2004/031059 A1, and thirty-eight (38) amended claims.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.

Olaf Bexhoeft

Olaf Bexhoeft
5316 Little Falls Rd.
Arlington, VA 22207-1522

7/PRTS

10/529214
JC06 Rec'd PCT/PTO 25 MAR 2005

Specification

Method and Device for the Regulation of the Web Tension in a Multi-Web System

The invention relates to methods and a device for controlling the web tension in a multi-web system in accordance with the preambles of claims 1, 18, 21 or 22.

A method for controlling the web tension of several webs is known from EP 0 837 825 A2, wherein by means of the respective web tension of several webs their web tension levels in relation to each other are regulated by means of a regulation based on fuzzy logic.

A method for controlling web tensions in the course of multi-web operations is known from DE 100 27 471 A1, wherein absolute and relative tensions of the webs in relation to each other are initially set at the hopper inlet. This is preferably performed by means of the respective draw-in device.

The object of the invention is based on creating methods and a device for controlling the web tension in a multi-web system.

In accordance with the invention, this object is attained by means of the characteristics of claims 1, 18, 21 or 22.

The invention creates a system for the automatic regulation of the web tension for multi-web processing machines, in particular rotary printing presses. Because of its closed-loop regulation, it constitutes a considerable further development in comparison to web tension control

systems customary at present in rotary printing presses. The system is advantageous for triple- or double-width printing presses.

The regulation concept based on fuzzy logic makes an innovative contribution to increased production dependability and constant quality in a production process which, in view of costs, is increasingly directed toward less waste and fewer manual interventions. The regulation aids the operator during start-up of the press, reduces his participation in the course of controlling the web tension during the production run, and makes a contribution to increased stability in all phases of the production.

On its way through the rotary printing press from the roll changer via the draw-in unit, the printing units and the superstructure into the folding apparatus, a paper web undergoes different states of tension (or tension relief or tension profile), wherein the sort of paper used (manufacturer, grammation, paper type), the repeated application of printing ink, and possible dampening water (in the course of the offset process), the driven traction elements (draw-in unit with or without compensating rollers, traction rollers, hopper inlet rollers), as well as speed changes, affect the actual tension profile of the paper web inside the press. The regulation of a constant web tension during multi-web operations is even more demanding and complex. There, the relative tension of the individual paper webs in relation to each other at the superstructure, at the hopper inlet and in the folding apparatus is of importance for optimal web running and printing conditions.

In connection with modern newspaper offset printers, web tension systems on the basis of PID control devices have already been realized at present in the area of the roll changers and draw-in units with a compensation roller. The downstream-situated traction devices in the press (downstream of the printing groups and in the hopper inlet), however, are not comprehensively included and regulated. Therefore the coupling of the traction elements corresponding to the production situation to form a comprehensive, self-regulating web tension system is a particular advantage of the invention.

By means of the intelligent web tension regulation in accordance with the invention it is intended to assure an optimal web tension profile of each individual paper web within the press, as well as optimized tension profiles of the individual paper web in relation to each other, in order to increase the start-up dependability (by means of fewer down times as a result of malfunctions), to achieve a uniform print quality (fewer differences in registration), and to improve the running dependability during multi-web operations.

With the present regulation, the software on the basis of fuzzy logic sets the optimum tension level within the paper webs as a function of the situation at the hopper inlet and of the respective paper profiles and performs the optimal matching of the webs to each other. The behavior typical for a sort of each paper web is taken into consideration by means of the paper profiles, i.e. available information (for example tension-elongation characteristics) regarding the

behavior of the defined sort of paper. The knowledge of experts has been stored in the system for the rapid fixation of the setting logic.

The intelligent control system directly regulates the actually measured tension values of the paper web in the processing press rather than via motor moments indirectly based on elongation measuring and control. This results in advantages in respect to efficiency, as well as to positive effects on waste, production costs and operational ergonomics.

It is an important point that the regulation based on fuzzy logic technology employs expert knowledge, and the operator no longer must perform settings. The measured values regarding the production are obtained by "shopping" and the appropriate units for affecting the tension are directly addressed. In contrast to a discrete control device, with the present regulation system an ideal total solution is almost always found without having to exactly maintain a defined regulation value and a total solution, as with a discrete control device, could possibly not be obtained by means of it. This applies in particular to the control device dealing with the single web, which is provided with a specification from the control device dealing with all webs. However, it is advantageous if the last mentioned one operates by means of fuzzy logic in order to specify, if required, compromise solutions for conditions to the first mentioned control device.

Exemplary embodiments are represented in the drawings and will be described in greater detail in what follows.

Shown are in:

Fig. 1, a printing press with several webs,

Fig. 2, a schematic representation of a regulation with two control processes,

Fig. 3, a schematic representation of the regulation in Fig. 1,

Fig. 4, a graphic representation of the progress of the web tension along its path,

Fig. 5, a flow diagram of the web-related control process,

Fig. 6, a schematic representation of an allocation diagram,

Fig. 7, a flow diagram of the multi-web-related control process.

Paths of several, at least two webs B1, B2, B3, B4, for example webs B1, B2, B3, B4 of material, for example paper webs B1, B2, B3, B4, through a processing press, in particular a printing press, are shown in Fig. 1, together with schematically represented units, which substantially affect the web tension.

The web B1, B2, B3, B4, explained by way of example in connection with the web B1, is fed in from a supply device 01, for example a roll changer 01, and passes through at least one traction device (or braking device) 02 for its conveyance and setting of a web tension, for example a draw-in unit 02, before it passes through a processing stage 03, for example at least one printing unit 03 with one or several printing groups. The draw-in unit 02 can simultaneously represent an actuating member 02 for setting the tension

upstream of the printing unit 03. Following a last print location assigned to the web B1, the latter passes through a measuring location 04 (nDE, downstream of printing unit 03) for determining the web tension, and thereafter through an actuating member 05 affecting the web tension, for example a traction roller 05, or roller/traction group 05. Turning bars and longitudinal cutting devices can be arranged in a superstructure, not represented, by means of which either uncut webs B1 can be turned or tipped, or webs B1 first cut and then turned or tipped. Prior to the entry of the web B1 (or of the partial webs) into a so-called harp 07 (a plurality of deflection rollers assigned to several webs B1, B2, B3, B4, or to partial webs), a measuring location 06 (vTE upstream of the hopper entry) for determining the web tension is provided for each web B1 (or every partial web). The measuring location 04 "downstream of the printing unit" therefore means a measuring location 04 upstream of the traction element 05 following the printing unit 03, or at least upstream of a possibly provided cutting or turning device. Following the harp 07, the web B1 (or its partial webs), together with other webs B2, B3, B4 (or their partial webs), is brought together into one or several strands 13, passes a further actuating member 08 affecting the web tension, a traction roller 08 or roller/traction group 08, for example a so-called hopper inlet roller 08, before it is longitudinally folded by one or several hoppers 09, for example. Therefore, the measuring location 06 "upstream of the hopper inlet or harp" means a measuring location 06 for the single web or partial web prior to the bringing together of webs or partial webs at the hopper inlet roller 08 (or a

different roller, located upstream and assigned to several webs), and downstream of the traction element 05 or, if provided, downstream of a cutting and/or turning device. If the product is not wound up again, the webs B1, B2, B3, B4 (or partial webs) in the strand 13 pass through a further actuating member 10 affecting the web tension, a further traction roller 10 or roller/traction group 10, or folding traction rollers 10, and are transversely folded at least once in at least one folding apparatus 11. The above mentioned draw-in unit 02 has an actuating member 16 affecting the web tension, a traction roller 16, or a roller/traction group 16, or compensating roller 16 and possibly a separate measuring location 14 for determining the web tension (vDE: upstream of the printing unit 03). The actuating member 16 and the measuring location 14 can also be arranged between the roll changer 01 and the printing unit 03 without being combined into a draw-in unit 02. The separate measuring location 14 can be omitted if adequate information regarding the prevailing tension is provided by the actuating member 16, for example an actuating member 16 which can be actuated by means of a pressure medium.

In the printing press represented in Fig. 1, webs B1, B2, B3, B4 from printing units 03 arranged on different sides, are conducted by way of example to the hopper 09, wherein the hopper structure can have several hoppers 09 next to and/or underneath each other, and several strands 13 made of the webs B1, B2, B3, B4 can be conducted to more than one folding apparatus 11. Furthermore the webs B1, B2, B3, B4 need not each pass through a printing unit 03 in the schematically represented manner, but instead can, for

example after passing through a portion of a printing unit 03, be conducted out of it and can be conducted either immediately to the superstructure, or to another printing unit 03 for further processing. However, it is essential that the measuring locations 04, 06, 14, and the actuating members 05, 10, 16 are or will be assigned to the webs B1, B2, B3, B4 for their regulation, which will be explained in greater detail below.

In Fig. 1, the signals S1.1, S1.2, S1.3 from the web B1, or S2.1, S2.2, S2.3 from the web B2, etc., obtained by the measuring locations 04, 06, 14, are indicated by arrows. A signal S1.0, S2.0, S3.0, S4.0 (dashed lines) from a measuring location not identified, which describes the tension, can be obtained also in the area of the roll changer 01. Furthermore, the preset values for the actuating members 16, 05 in the form of signals S1.11, S1.12 for the web B1, or S2.11, S2.12 for the web B2, etc. are represented by arrows. For example, the signal Sx.11 represents a preset value (desired value) for the web tension in the draw-in unit 02, the signal Sx.12 a preset value (desired value) for the advance of the traction roller 05. The signals S0.13, S0.14 represent the preset values (desired values), for example the advance, of the actuating members 08 and 10. A possibly existing preset value (desired value) for the web tension in the area of the roll changer 02 is identified by S1.10 for the web B1, with S2.10 for the web B2, etc.

The printing press in Fig. 1 has a control system 17, whose concept will first be explained in principle by means of Fig. 2, and which is represented in Fig. 3 directly relating to the web tension of several webs B1, B2, B3, B4 in

Fig. 1, at least to several webs B1, B2, B3, B4 (or partial webs), which together run up on at least one hopper roller 08.

The control system 17 has two types of control devices 18 and 19, which differ from each other and have two partial tasks (control processes) differing from each other. These two "types" of control devices 18 and 19 can be embodied as different hardware components spatially separated from each other, as different software programs communicating with each other, or as two processes, or sub-programs or sub-routines, of a software program. If not explicitly otherwise mentioned, in what follows ,the terms control device 18, 19, or control processes 18, 19, are shown with the same reference symbols and should be understood to apply to all above mentioned and other suitable possibilities of the conversion of the same. As represented in Fig. 2, the control system has several (here two) control devices 18.1, 18.2, each of which is provided with actual values from a respective partial process and which generate by means of their implemented logic one or more actuating values regarding the observed partial process. The control device 19 is of a higher order than the control device 18 and receives actual values from the partial processes and outputs by means of its implemented logic preset values for the lower-order control devices 18.1, 18.2, as well as actuating values directed to the entire process, if required. There is no mutual interaction or communication between the control device 18 and 19. Although they can operate simultaneously, in principle they operate independently of each other, even though in part they observe the same process values (actual

values), and the control process 19 creates preset values (desired values) for the control processes 18.

Memory devices 21 are also represented in Fig. 2, from which starting values can be read into the control device 18, 19 prior to the start of the processes. The starting values are advantageously read in from a common memory unit 21.

At least two measured values from each one of the web paths involved, namely the measured values S1.2, S2.2, S3.2, S4.2 for the tensions, are provided to the control system 17 in accordance with Fig. 3 for example from the measuring location 04, designed as a measuring roller 04, (direct) downstream of the respective printing unit 03, as well as the measured value S1.3, S2.3, S3.3, S4.3 from the respective measuring location 06 upstream of the hopper inlet, or the harp 07. In the case of the measured values S1.3, S2.3, S3.3, S4.3 and the measuring location 06, this also applies to turned partial webs assigned to this hopper inlet. In a further development, the signal S1.1, S2.1, S3.1, S4.1 for the respective tension upstream of the printing unit 03 can be supplied if needed (dashed lines). The measurement of the tension is respectively provided by measuring rollers, around which the web B1, B2, B3, B4 is wound.

The control system 17, at least the control device 18, regulates and optimizes the web tensions, preferably by using fuzzy logic. The input values, such as for example the measured values S1.3, S2,3, etc. of the tensions (appropriately scaled, if required) of a web B1 are fuzzyfied, i.e. are used as input values for functions defined in sections, each of which describes a term

(linguistic value range, for example large, medium small). The degree to which the input value meets the linguistic meaning of the term or, in case of an overlap of the value ranges, the degree to which it is met, is obtained as a functional value. In the course of the subsequent defuzzyfication, a solid output value, for example an appropriate signal to an actuating member or a new desired value for an actuating member, is generated from the degree to which the individual terms of the linguistic variable have been met. Depending on the result of defuzzyfication it is possible to provide preset values to one actuating member, to another actuating member or several actuating members. Which rules are applied is determined by means of the degree the terms of the input values have been met. An above mentioned example with the two input values (for example measured values S1.3, S1.2) and one output value (for example signal S.12 to an actuating member, for example the roller/traction group 05) of preset rules, which are available in the form of a table, for example, could be graphically represented as a three-dimensional characteristic diagram, for example. If more input values are entered into a decision process, and/or if it is intended to create several output values, the "characteristic diagrams" are correspondingly multi-dimensional. The control devices 19 need not be based on fuzzy logic, instead it can be designed in other ways, for example as a PID control device 19. However, the embodiment with fuzzy logic is also of advantage here.

As generally represented above, the control system 17 has the two control devices 18 and 19, which are different from each other and have two partial tasks differing from

each other, wherein the control device 18 regulates the web tension of a single web B1, B2, B3, B4 on its path and in view of threshold values, and the control device 19 sets the tension level, in particular the tension level upstream of the hopper inlet roller 08, of the webs B1, B2, B3, B4 which are combined there, in relation to each other.

The control system 17 has a number of control devices 18, which at least corresponds to the total number of webs B1, B2, B3, B4 (or partial webs), which are to be brought together. All of the control devices 18 have the same architecture, or are programmed in the same way, and are identified by 18.1, 18.2, 18.3, 18.4 for the webs B1, B2, B3, B4 represented in Figs. 1 and 2. The control device 19, or the process 19, are assigned to the four control devices 18.1, 18.2, 18.3, 18.4, or processes 18.1, 18.2, 18.3, 18.4.

In connection with start-up processes it is advantageous to preset starting values in the control system 17 as desired values which, for example, provide meaningful starting points for a defined web guidance. In the example it is therefore possible to specify starting values S1.11_0, S1.12_0, S2.11_0, S2.12_0, S3.11_0, S3.12_0, S4.11_0, S4.12_0, S0.13_0 and/or S014_0, for the signals S1.11, S1.12, S2.11, S2.12, S3.11, S3.12, S4.11, S4.12, S0.13 and/or S0.14 (tensions or advances) to the control device 18.1, 18.2, 18.3, 18.4, 19. These are preset in a memory for example, and can be a function of the selected production and/or the web material.

When operating the control system, first every web B1, B2, B3, B4, considered solely by itself, is controlled by means of the control devices 18.1, 18.2, 18.3, 18.4, or of

the processes 18.1, 18.2, 18.3, 18.4, in a first partial task, so that the tension at the measuring location 06 upstream of the hopper inlet lies between a minimum, for example MIN = 8 dN/m, and a maximum, for example MAX = 60dN/m. A second demand made on the first partial task possibly lies in setting the stepping, schematically represented in Fig. 4, of the tensions at the measuring location 14 (upstream of the printing unit 03), 04 (downstream of the printing unit 03), and 06 (upstream of the hopper inlet, or prior to the bringing together). In addition, the process-related minimum tensions (for example 8daN) and maximum tensions (60daN) must additionally be maintained. It is therefore the task of the control devices 18.1, 18.2, 18.3, 18.4. of the processes 18.1, 18.2, 18.3, 18.4, to adjust the tension of the individual webs B1, B2, B3, B4 at the hopper inlet, in particular on their way to it, to the range permitted in principle, and in addition to achieve the correct stepping within the web path of the individual webs B1, B2, B3, B4, if necessary.

To achieve this partial task, the control devices 18.1, 18.2, 18.3, 18.4, in what follows by way of example for the control device 18.1 of the web B1, are each provided with at least two signals S1.2 (downstream of the printing unit 03) and S1.3 (upstream of the hopper inlet or the bringing together) of the measured tension of the same web B1. The control device 18.1 processes these input values in the above explained manner by means of fuzzy logic and generates an output signal S1.11, which acts on the actuating member 16 of the draw-in unit 02. In the simplest embodiment of the control device 18.1, or process 18.1, only the two above

mentioned input signals S1.2, S1.3 are supplied and an output signal S1.11 is only sent to the actuating member 16 upstream of the printing unit 03. It is optionally possible to supply the control device 18.1 additionally with the signal S1.11 for measuring the tension upstream of the printing unit 03, which can also be processed in the logical device.

In an advantageous solution, the control device 18.1 additionally also acts with a signal S1.12 on the actuating member 05 downstream of the printing unit 03, for example by determining and specifying suitable advancement values. With this embodiment an improved setting of the course of the tension over the path of the web B1 is possible. In connection with this, the control concept takes place for example in such a way that it is first attempted by means of the actuating member 16 to meet the requirements regarding minimum/maximum tension and simultaneously the desired course of the tension. If this is not possible by acting on the actuating member 16 alone, the actuating member 05 is included.

In a substantially self-explanatory manner, Fig. 5 represents the progression of the control process 18.x by means of the example of the control process 18.1. Without repeating was has been said above, it becomes clear that a preset value, in particular for the measuring location 06 upstream of the hopper inlet, from the control process 19 is read in. This actual preset value is compared with the last valid one and, in case of a deviation, one or several of the allocation diagrams on which the subsequent calculations are based is changed, in particular shifted. The subsequent calculations, for example of a shifting of the desired value

for the draw-in unit 02 and/or the calculation of a draw-in roller displacement of the traction device 05, then take place on the basis of the unchanged or changed allocation diagrams, or of the unchanged or changed allocation diagram by means of fuzzy logic, after the measured values 1.2, S1.3 and, if required, S1.1, have been read in. At the start of production of the press, starting values are read in from a memory device 21 instead of the preset values from the process 19. The partial process prior to the inquiry regarding the press status (in production?) is a part of the initialization of the system. The inquiries are answered in the diagrams with "true" (w) or "false" (f). The connection with the arrow from the lowest node of the process to the node prior to the inquiry makes it clear that this is a process which is continuously performed as long as the press is in production.

The principle of the above mentioned change or shifting of an allocation diagram is schematically represented in Fig. 6. In a first stage of the diagram, a measured value Sm has first values for weighting of "small" and "medium". After the allocation functions have been shifted (defined in sections), the measured value Sm is faced with different weighted values "small'" and "medium'". This change in the weighting is now reflected in the total view of all fuzzy rules and in the end possibly leads to a shifting of the desired values in respect to the actuation value in question, here for example the actuating value S1.11 for the draw-in unit 02.

In a second partial task a check is made by the control device 19, or the control process 19, whether upstream of the

harp 07 the tensions of the webs B1, B2, B3, B4, which are to be combined, are in the desired relationship in respect to each other, and this is controlled accordingly. Thus, for example, the lowest web B1, B2, B3, B4 which comes to rest on the traction roller 08, in this case the web B3, should have a greater tension than the one above it, etc. Therefore the second task is to step, or align, the mutual tensions in the webs B1, B2, B3, B4, which are to be conducted on top of each other, in the area of the hopper inlet. Here, the minimum requirement, that $S_n \geq S_{n+1}$, applies to all S1.3, S2.3, S3.3, S4.3, etc., if n identifies a web B1, B2, B3, B4, and n+1 the outwardly adjoining web B1, B2, B3, B4. As a side constraint the following applies to all webs B1, B2, B3, B4: $MAX \geq S_1 \geq S_2 \geq S_3 \geq S_4 \geq MIN$, if the index characterizes the sequence of the webs B1, B2, B3, B4 from the inside to the outside. In addition, a rule for the optimum state advantageously exists which states that $S_n \geq S_{n+1}$ + Delta S, wherein Delta S = 2dan/m, for example.

In the second partial task (or the first control process 19), the tensions in the various webs are varied, for example, in such a way that the tension of all webs B1, B2, B3, B4 upstream of the hopper inlet roller 08 lies within the tolerance range (Fig. 4, upstream of the hopper entry (vTE)). For this purpose, the signals S1.3, S2.3, S3.3, S4.3 of the measured values of the web tension are supplied to the control device 19 parallel with the control device 18.1, 18.2, 18.3, 18.4. In a further development, fuzzy logic is also the basis for the control device 19, or control process 19, by means of which preset values for the control devices 18.1, 18.2, 18.3, 18.4, as well as signals S0.13 and S0.14

for the actuating members 08 and 10, which work together with the strand 13, are generated as output values from the input values (signals S1.3, S2.3, S3.3, S4.3).

Fig. 7 represents, again in a self-explanatory way, the flow of the control process 19. As can be seen, it is possible to preface the actual partial process for the matching of the tensions Sx.3 among each other with a partial process which, as represented, checks the total web tension level on the basis of the individual measured values Sx.3 and, if required, raises or lowers the total level of all webs/partial webs running over the roller 08 by adjusting (for example the advance) this hopper inlet roller 08. The partial process contains the steps of reading in the measured values - checking the total web tension - and, depending on the result, of calculating and outputting (f) the shifting of the hopper inlet roller, or to leave it as it is (w).

In case of a deviation (f) of the adjustment of the tensions among each other from the preset relationship (MAX ≥ S1.3 ≥ S2.3 ≥ S3.3 ≥ S4.3 ≥ MIN) and/or the threshold values, preset values are calculated for the respective correction processes 18.x, or the respective correction process 18.x, in particular for the measuring location 06 upstream of the hopper inlet, and are output. Here, too, the calculation can take place by means of fuzzy logic wherein, for example, again allocation diagrams, which are the basis of the calculation, are shifted in accordance with the deviations. At the production start of the press, starting values from a memory device 21 are read in instead of the preset values from the process 19. The partial process prior to the

inquiry regarding the press status (in production?) is a part of the initialization of the system.

In an advantageous embodiment, the control device 19, or the control process 19, has no direct influence on the actuating members 16, 05 assigned to the individual webs B1, B2, B3, B4, but provides preset values to the control devices 18 from the signals S1.3 to S4.3 by means of its characteristic diagram. This preset value merely relates to a tension to be maintained upstream of the hopper roller 08 per web B1, B2, B3, B4, i.e. a desired value for the tensions to be maintained, for example, at the measuring locations 06. These preset values, for example because of a change in the position and/or form of the terms, or the input values in the course of the fuzzyfication, are entered in the control device 18.x (see above). Therefore an actuating member 02, 05, 16 assigned to an individual web B1 to B4 is not randomly addressed by two different processes, which would result in an unsteady or even unstable control behavior. In contrast to this, the request from the control process 19 is taken into consideration in the control process 18.x. The advantageous performance of this partial process in the control device 18.x in the form of fuzzy logic now makes it possible for the request or preset value from the control device 19 not necessarily having to be performed exactly as prescribed, but instead being performed within the scope and in view of the entire control task of the control device 18.x. Only the allocation diagrams regarding the preset values from the control device 19 are shifted, and these newly weighted criteria are taken into consideration when

determining the optimal (or at least permissible) total state. The connection with the arrow from the lowest node of the process to the node prior to the inquiry of the press status makes it clear that this is a process which is continuously performed as long as the press is in production.

These two control processes 18 and 19, or the partial tasks connected therewith, are cyclically repeated and, corresponding to the measurement results and the results from the logical device, the units affecting the web tension, for example traction rollers 16, 05, 08, 10, or not represented compensating rollers, etc. are charged, Besides the above mentioned units, such as in the draw-in unit 02 and/or one or several traction rollers 16, 05, 08, 10, these can also additionally be devices in the roll changer 01 and/or devices in the folding apparatus 11. What had been said above in connection with Fig. 3 then must be complemented by appropriate signals, for example S1.10, for the roll changer 01, or not represented signals for the folding apparatus 11.

In an advantageous embodiment, the control of such units by means of the control system 17 takes place while taking a priority into account: for example, as explained above, in a first priority the entry of the desired value by the control system 17 is performed only for the draw-in unit 02. If the two above mentioned tasks cannot be performed with this step alone, the traction roller 05 downstream of the printing unit 03 is acted upon. If necessary, in a third step it is permissible to influence the hopper inlet roller 08. However, in the course of this the level of all affected webs B1, B2, B3, B4 is shifted. The actuating members, traction roller 05 or hopper inlet roller 08, are only used

in case the global web tension of all webs B1, B2, B3, B4 is not correct, or if the actuating range of the draw-in unit 02, or its actuating member 16, is not sufficient for the desired web tension.

If the requirement of the second partial step, i.e. the desired stepping, cannot be achieved, the logic of the control system, in particular of the control device 19, can be embodied to reach a state which approaches an ideal state as closely as possible. Still acceptable limits for the deviation (relative or absolute) can be preset and, if necessary, changed. In addition, in an advantageous further development the control system can be designed to issue a cautionary advice in case of too great a deviation from the permissible tension profile (of a web) or the stepping (all webs in respect to each other) and, if required, in case of an impermissibly large deviation, to cause the stop of the processing press.

However, in the simplest embodiment the control system 17 operates with two types of measurement of the tension of each of the involved webs B1, B2, B3, B4, namely respectively downstream of the printing unit 03 and upstream of the hopper inlet, wherein the action takes place respectively first at the draw-in unit 02 and, if required, in the second step in the area of the traction roller 05.

As already mentioned above, following the cutting of a web B1, B2, B3, B4, several partial webs assigned to a roll changer 01 can be conducted to the hopper 09 along paths which differ from each other. In this case the tension of each partial web is determined upstream of the hopper inlet, for example each at its own measuring location 06. These

measured values assigned to a common roll changer 01, for example S1.3a and S1.3b, are linked, either before they are conducted to the control system 17, or in the control system 17, i.e. in the control device 18, as well as in the control device 19, to form a value, are for example averaged with or without weighting, and the resulting value is employed as an actual value for the control. This linkage can be integrated into the respective control devices 18, 19 as a logical component 22, or sub-process 22, which is represented by dashed lines by way of an example.

Preferably the roll changer 01 and the draw-in unit 02 have a closed control loop in addition to the control system 17, which is provided with a specified desired value by the control system 17. The traction rollers 05, 08, 10, 16 are controlled by the control system 17 only in respect to their advancement (number of revolutions, angular position). The units involved are specified by their advantageous embodiments for influencing the tension.

The draw-in unit 02 has a closed loop control, the provision of preset desired values by the control system 17, in particular by the control device 18, is dependably maintained. It acts on the entire web B1, B2, B3, B4 and is considered to be the most important actuating member. In an advantageous embodiment, the draw-in means 02 has a roller as the actuating member 16, which can be moved counter to the tractive force of the web B1, B2, B3, B4 and which, by means of pressure means of a specified pressure force, counteracts the tractive force of the web. In this case no separate measuring location 14 is required, provided the correlation

between the charged pressure and the resultant web tension is known.

By changing the advancement in relation to the paper web speed, the traction roller 05 can act on the web tension of the actual web B1, B2, B3, B4, and here constitutes the last chance upstream of the hopper inlet roller 8 for influencing an individual web B1, B2, B3, B4 in regard to its tension, or stepping.

By changing the advancement in relation to the paper web speed, the hopper inlet roller 08 can act on the web tension of all webs B1, B2, B3, B4.

The folding traction roller 10 can also act on the web tension of all webs B1, B2, B3, B4 by means of a change of its advancement in relation to the paper web speed. It has direct effects on the cutting registration.

A modular construction, for example, allows the extension of the control to several webs, in case of a separate solution by means of the hardware it is merely necessary to add a further control device 18, for example a fuzzy SPS with a program, to each further web B1, B2, B3, B4. It is furthermore necessary to inform the program of the control device 19, for example the master SPS, that it must incorporate a further web B1, B2, B3, B4.

In a pure software solution for the control devices 18 and 19, it is only necessary in case of an expansion by one web B1, B2, B3, B4 to increase the software by one control process 18.x and to inform the program of the control process 19.

Control by means of the control devices 18 and 19 can run purely sequentially, but also parallel, viewed chronologically wherein, however, in view of the tension to be set upstream of the hopper inlet roller 08, for example at the measuring location 06, the control is hierarchically constructed and the control device 19 is of a higher order than the control devices 18.

In an advantageous further development, the control system 18 is embodied in such a way that a setting for a defined configuration of the print application, found by means of the control system 17, a web path and/or a defined product can be transmitted as a specified value to the memory device, so that these can be read in as starting values in the future in an identical or similar production situation. For this purpose, the takeover of the product or production values takes place from the press control and/or product planning. The takeover as new starting values can be triggered, for example, as a result of a decision of the operators, or by the system itself if the control and/or the control system are designed as a self-learning system in respect to this function.

List of Reference Numerals

01	Supply, roll changer
02	Actuating member, traction/braking arrangement, draw-in unit
03	Processing stage, printing unit
04	Measuring location for the web tension downstream of the printing unit
05	Actuating member, traction roller, roller/traction group
06	Measuring location for the web tension upstream of the hopper inlet
07	Harp
08	Actuating member, roller/traction group, hopper inlet roller
09	Hopper
10	Actuating member, roller/traction group, folding traction roller
11	Folding apparatus
12	-
13	Strand with several paper webs
14	Measuring location upstream of the printing unit
15	-
16	Actuating member, roller/traction group, compensating roller
17	Control system
18	Control device, control process
19	Control device, control process

20	-
21	Memory device
22	Component, sub-process
B1	Web, web of material, paper web
B2	Web, web of material, paper web
B3	Web, web of material, paper web
B4	Web, web of material, paper web
S1.1	Signal, measured value of the web tension upstream of the printing unit of the web (B1)
S1.2	Signal, measured value of the web tension downstream of the printing unit of the web (B1)
S1.3	Signal, measured value of the web tension upstream of the hopper inlet of the web (B1)
S1.10	Signal, preset value of the web tension in the roll changer of the web (B1)
S1.11	Preset value of the web tension in the draw-in unit of the web (B1)
S1.12	Preset value of the advancement of the traction roller of the web (B1)
S2.1	Signal, measured value of the web tension upstream of the printing unit of the web (B2)
S2.2	Signal, measured value of the web tension downstream of the printing unit of the web (B2)
S2.3	Signal, measured value of the web tension upstream of the hopper inlet of the web (B2)

S2.10	Signal, preset value of the web tension in the roll changer of the web (B2)
S2.11	Preset value of the web tension in the draw-in unit of the web (B2)
S2.12	Preset value of the advancement of the traction roller of the web (B2)
S3.1	Signal, measured value of the web tension upstream of the printing unit of the web (B3)
S3.2	Signal, measured value of the web tension downstream of the printing unit of the web (B3)
S3.3	Signal, measured value of the web tension upstream of the hopper inlet of the web (B3)
S3.10	Signal, preset value of the web tension in the roll changer of the web (B3)
S3.11	Preset value of the web tension in the draw-in unit of the web (B3)
S3.12	Preset value of the advancement of the traction roller of the web (B3)
S4.1	Signal, measured value of the web tension upstream of the printing unit of the web (B4)
S4.2	Signal, measured value of the web tension downstream of the printing unit of the web (B4)
S4.3	Signal, measured value of the web tension upstream of the hopper inlet of the web (B4)
S4.10	Signal, preset value of the web tension in the roll changer of the web (B4)

S4.11	Preset value of the web tension in the draw-in unit of the web (B4)
S4.12	Preset value of the advancement of the traction roller of the web (B4)
S0.13	Signal, preset value of the advancement of the hopper inlet roller
S0.14	Signal, preset value of the advancement of the folding traction roller
S1.3a	Measured value
S1.3b	Measured value
S1.0	Signal, measured value of the web tension in the area of the roll changer (01)
S2.0	Signal, measured value of the web tension in the area of the roll changer (01)
S3.0	Signal, measured value of the web tension in the area of the roll changer (01)
S4.0	Signal, measured value of the web tension in the area of the roll changer (01)
18.1	Control device
18.2	Control device
18.3	Control device
18.4	Control device
x	Space indicator for the web (B1, B2, B3, B4)

nDE	Downstream of the printing unit (03)
vTE	Upstream of the hopper inlet
vDE	Upstream of the printing unit (03)
vEW	Upstream of the draw-in unit